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<b>(54) Title:</b> TRANSLATERAL SPINAL IMPLANT  <b>(57) Abstract</b>  An oversized spinal implant for translateral insertion into the disc space between two vertebrae a length that is greater than one half of the transverse width of the vertebrae and is greater than the depth of the vertebrae. The translateral implant of the present invention has a height that is greater than the height of the disc space between two adjacent vertebrae so as to engage both of the vertebrae. The width of the implant need be only slightly less than the depth of the vertebrae themselves. The translateral spinal fusion implant of the present invention has more surface area of contact and thus permits greater stability so as to withstand torque, and in the case of a threaded implant, increases the depth which any threads are able to penetrate the vertebrae.		

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**TRANSLATERAL SPINAL IMPLANT****BACKGROUND OF THE INVENTION****Related Applications**

5 This is a continuation in part of copending  
Application Serial No. 08/074,781 entitled THREADED SPINAL  
IMPLANT filed on June 10, 1993, which is a continuation in  
part of Application Serial No. 07/698,674 filed on May 10,  
1991 which is a divisional of Application Serial No.  
10 07/205,935 filed on June 13, 1988, now United States Patent  
No. 5,015,247 all of which are incorporated herein by  
reference.

This application is also continuation in part of  
copending Application Serial No. 08/263,952 entitled  
15 ARTIFICIAL SPINAL FUSION IMPLANTS filed on June 22, 1994,  
which is a continuation of Application Serial No.  
08/052,211 filed on April 22, 1993, which is a continuation  
of Application Serial No. 07/546,849, filed on July 2,  
1990, which is a continuation of Application Serial No.  
07/212,480 filed on June 28, 1988, all of which are  
20 incorporated herein by reference.

This application is also a continuation in part of  
Application Serial No. 08/390,131 entitled IMPROVED  
INTERBODY SPINAL FUSION IMPLANTS filed on February 17,  
1995, incorporated herein by reference.

25 This application is also a continuation in part  
of Application Serial No. 08/394,836 entitled IMPROVED  
METHODS AND INSTRUMENTATION FOR THE SURGICAL CORRECTION OF  
HUMAN THORACIC AND LUMBAR SPINAL DISEASE FROM THE LATERAL  
ASPECT OF THE SPINE, filed on February 27, 1995,  
30 incorporated herein by reference.

Field of the Invention

This invention relates generally to spinal fusion implants, and more particularly to spinal fusion implants for insertion from the side of a patient (translateral) across the transverse width of the spine and between two adjacent vertebrae.

Description of the Related Art

In the past, spinal fusion implants have been inserted only from either an anterior or posterior direction, from the front or the back of the patient. Such implants are well known in the art and may have cylindrical, rectangular and other shapes. In the past, Cloward, Wilterberger, Crock, Viche, Bagby, Brantigan, and others have taught various methods involving the drilling of holes across the disc space between two adjacent vertebrae of the spine for the purpose of causing an interbody spinal fusion. Cloward taught placing a dowel of bone within that drilled hole for the purpose of bridging the defect and to be incorporated into the fusion. Viche taught the threading of that bone dowel. Bagby taught the placing of the bone graft into a metal bucket otherwise smooth on its surface, except for rows of radially placed holes communicative to the interior of the basket and to the bone graft. The Bagby device was disclosed as capable of being used in a horse. Brantigan taught the use of inert blocks preferably made of metal and having that metal at its external surface imitate the porosity of bone. Brantigan theorized that the bone dowel could be replaced entirely with a metal plug that, while not itself active in the fusion, would nevertheless serve to support the vertebrae from within the disc space while allowing fusion

to occur around it.

U.S. Patent No. 3,844,601 issued to Ma et al. on November 19, 1974, teaches a method and instrumentation for preparing rectangular spaces across the disc space into the adjacent vertebrae and for preparing a rectangular graft of the bone itself that is inserted in the rectangular spaces.

U.S. Patent No. 4,743,256 issued to Brantigan on May 10, 1988 teaches the use of an inert artificial spacer in the shape of a rectangle in place of using a rectangular bone graft as taught by Ma et al.

U.S. Patent No. 4,878,915 issued to Brantigan on November 7, 1989, teaches the use of fully cylindrical inert implants for use in interbody spinal fusion. Such implants do not participate in the bone fusion process but act as inert spacers and allow for the growth of bone to the outer surfaces of the implants.

U.S. Patent No. 4,834,757 issued to Brantigan on May 30, 1989, teaches a rectangular shaped, hollow spinal fusion implant for use in lieu of a rectangular bone graft or Brantigan's earlier artificial inert spacer.

However, all of the prior implants have been inserted from either the front or the back of the patient. As a result, the spinal fusion implants of the past were necessarily limited in size to the dimensions of the vertebrae relative to the direction in which the implants were inserted. For example, the maximum possible length for an implant that is inserted from either the front or the back of the patient is limited to the depth of the vertebrae, the depth of a vertebrae being the dimension of the vertebrae measured from the anterior end to the posterior end of the vertebrae. It was not previously

possible to insert an implant that had a length that was greater than the depth of the vertebrae from front to back as such an implant would protrude from either the anterior or posterior aspect of the spine resulting in great harm to the patient.

In U.S. Patent No. 5,015,247 to Michelson, a cylindrical threaded implant is described for insertion across the disc space between two adjacent vertebrae. Such an implant was disclosed as being inserted either from the front of the patient or from the back and has a diameter larger than the disc space so that it engages both of the adjacent vertebrae.

The maximum diameter possible with a cylindrical implant that is inserted from the front or the back of the patient is limited by at least two factors. The first factor limiting the diameter of a cylindrical implant is realized when an attempt is made to use a single, centrally placed implant from either the front or the back of the patient. Such an implant must be large enough to occupy a sufficient portion of the transverse width of the disc space to promote firm stability. The use of an implant that is placed in the disc space to stabilize the two adjacent vertebrae requires that the vertebrae be stable when the implant is in place, otherwise there will not be any bone bridging between the implant and the vertebrae. If a single implant is used in the center of the disc space, inherent instability is created, as the vertebrae are generally free to rock back and forth over the implant which serves as a fulcrum. However, to achieve the required stability, it would be necessary to use the widest possible implant and the excursion of such a large single

implant into the adjacent vertebrae would be so severe that the two vertebrae would be virtually cut in half.

5 The second factor which limits the diameter size of a cylindrical implant is in the situation where two cylindrical implants are implanted from either the front or the back of the patient and placed side-by-side across a disc space and into the two adjacent vertebrae in an attempt to gain stability while avoiding the problems of the single implant. Such implants require a diameter that  
10 is sufficiently large to penetrate into and significantly engage each of the adjacent vertebrae yet the diameter may not be so large that it is no longer possible to place two such implants side-by-side and to still have them contained within the transverse width of the spine.

15 The use of multiple implants requires that the implants be small enough so as to fit into the same limited spinal width. These implants being of smaller diameter as limited by the need to place more than one within the width of the spine then penetrate only minimally into the depth  
20 of the vertebral bone.

Also, the insertion of multiple implants requires multiple procedures, essentially a duplication of any procedure done on one side of the center line must also be performed on the other side of the center line.

25 Therefore, there exists a need for a spinal fusion implant that is inserted from the translateral approach to the spine that is capable of stabilizing the vertebrae adjacent to such an implant in order to permit bone bridging between the vertebrae and the implant to  
30 ultimately achieve fusion of the adjacent vertebrae.

SUMMARY OF THE INVENTION

The present invention discloses a spinal fusion implant that is inserted from the side of the patient, herein referred to as the translateral approach to the spine. The translateral spinal fusion implant of the present invention is inserted into the spine of a patient across the transverse width of the vertebrae to be fused. The transverse width of a vertebra is measured from one lateral aspect of the spine to the opposite lateral aspect. The depth of a vertebra is measured from the anterior aspect to the posterior aspect of the spine.

As the translateral spinal fusion implant of the present invention is inserted substantially along the transverse width of the vertebrae or at a slight angle to the vertebrae, it has a different structural configuration as compared to spinal implants for insertion from either the front or the back of the patient, as such implants are necessarily limited by the depth, measured from front to back of the vertebrae.

In one embodiment of the translateral spinal fusion implant of the present invention, the implant is dimensioned to fit within a bore created across the disc space and into the adjacent vertebrae. Such an implant may be substantially cylindrical and has an outer surface comprising bone engaging means for engaging the implant to the adjacent vertebrae. In this embodiment, for the lumbar spine, the translateral spinal fusion implant of the present invention has a length that is greater than one half of the transverse width of the vertebrae and is greater than the depth of the vertebrae. The translateral implant of the present invention has a height that is



greater than the height of the disc space between two adjacent vertebrae so as to engage both of the vertebrae. The width of the implant need be only slightly less than the depth of the vertebrae themselves.

5           In another embodiment of the present invention, the translateral spinal fusion implant of the present invention is dimensioned to fit within the disc space created by the removal of disc material between two adjacent vertebrae. Such an implant is inserted from the  
10           translateral approach to the spine and has a length that is substantially greater than the depth of the vertebrae and a width that approximates the depth of the vertebrae. The height of such an implant is approximately the same height of the normal height of the disc space between two adjacent  
15           vertebrae and may be wedged so as to reproduce anatomic lordosis. The upper and lower surfaces of such an implant may be contoured so as to conform to the shape of the disc space and the adjacent vertebral endplate surfaces.

          The dimensions of the translateral spinal fusion  
20           implant of the present invention permits a single implant to be inserted by a single procedure into the spine and to engage more of the adjacent vertebrae. As a result, the translateral spinal fusion implant of the present invention has more surface area of contact and thus permits greater  
25           stability so as to withstand torque, and in the case of a threaded implant, increases the depth which any threads are able to penetrate the vertebrae.

          The translateral implants of the present invention are safer to use than implants inserted from the  
30           front or the back as the aorta and vena cava lie anterior to the spine and the dural sac and nerves posteriorly, all

of which structures are simply avoided in the lateral approach.

5 The translateral spinal fusion implant of the present invention may be inserted into the disc space through a hollow tube which is engaged to the lateral aspect of the spine through a lateral, anterior, or anterolateral incision making the procedure safe and simple.

10 The translateral spinal fusion implant of the present invention may comprise at least in part fusion promoting and/or bioactive materials for active participation of the implant in the spinal fusion process.

#### OBJECTS OF THE PRESENT INVENTION

15 It is an object of the present invention to provide a spinal fusion implant that may be inserted from a translateral approach to the spine.

20 It is another object of the present invention to provide a spinal fusion implant that is safer to use than the implants of the past.

It is another object of the present invention to provide a spinal fusion implant that is easier to insert into the spine.

25 It is a further object of the present invention to provide a spinal fusion implant that provides greater stability of the vertebrae being fused.

It is yet another object of the present invention to provide a spinal fusion implant that is less likely to fail.

30 It is another object of the present invention to provide a spinal fusion implant that is more deeply

embedded into the adjacent vertebrae.

These and other objects of the present invention will become apparent from a review of the accompanying drawings and the detailed description of the drawings.

5

#### BRIEF DESCRIPTION OF THE DRAWINGS

Figure 1 is a perspective side view of the translateral spinal fusion implant of the present invention having an external thread for engaging the bone of two adjacent vertebrae.

10

Figure 2 is an elevational view of the anterior aspect of a segment of the spinal column with the spinal fusion implant of Figure 1 inserted from the lateral aspect along the transverse width of the vertebrae.

15

Figure 3 is an elevational view of the lateral aspect of a segment of the lumbar spine with a first spinal fusion implant of the present invention inserted from the lateral aspect into a hole drilled across a first disc space and into two adjacent vertebrae, and a second spinal fusion implant of the present invention inserted from the lateral aspect into a second hole drilled across a second disc space and into two adjacent vertebrae.

20

Figure 4 is top sectional view along lines 4--4 of Figure 3 showing the area of contact of the spinal fusion implant of the present invention and the vertebra.

25

Figure 5 is an anterior elevational view of a segment of the lumbar spine with two cylindrical implants inserted from the anterior of the spine into holes drilled across the same disc space and into two adjacent vertebrae.

30

Figure 6 is sectional view along lines 6--6 of Figure 5 showing the area of contact between the two

implants of Figure 5 and the vertebra.

Figure 7 is a anterior perspective view of a single vertebra and an alternative embodiment of the spinal fusion implant of the present invention in the form of a dowel inserted translaterally into a hole drilled across a disc space and into the vertebra along the transverse width of the vertebra.

Figure 8 is a perspective view of an alternative embodiment of the spinal fusion implant of the present invention having ratchetings for engaging the vertebrae.

Figure 9 is a perspective view of an alternative embodiment of the spinal fusion implant of the present invention having a knurled surface for engaging the vertebrae.

Figure 10 is a perspective view of an alternative embodiment of the spinal fusion implant of the present invention having ratchetings for engaging the vertebrae and a flattened side.

Figure 11 is a perspective view of an alternative embodiment of the spinal fusion implant of the present invention having a knurled surface for engaging the vertebrae and a flattened side.

Figure 12 is a perspective view of an alternative embodiment of the spinal fusion implant of the present invention having a blasted surface for engaging the vertebrae.

Figure 13 is a perspective view of an alternative embodiment of the spinal fusion implant of the present invention having ratchetings for engaging the vertebrae with openings in the form of vertical and horizontal slots.

Figure 14 is a perspective view of an alternative

embodiment of the spinal fusion implant of the present invention having longitudinal splines for engaging the vertebrae and openings in the form of vertical slots.

5 Figure 15 is elevational view of the lateral aspect of the spinal column having the spinal fusion implant of Figure 14 inserted from the lateral aspect along the transverse width of the vertebrae into a hole created across the disc space and into two adjacent vertebrae.

10 Figure 16 is a perspective side view of an alternative embodiment of the spinal fusion implant of the present invention.

15 Figure 17 is a elevational anterior view of a segment of the spinal column having the spinal fusion implant of Figure 16 inserted from the lateral aspect in the disc space between two adjacent vertebrae along the transverse width of the vertebrae.

Figure 18 is a perspective side view of an alternative embodiment of the spinal fusion implant of the present invention.

20 Figure 19 is a perspective lateral anterior view of a segment of the spinal column with a plurality of the spinal implants of Figure 18 shown in hidden line inserted from the lateral aspect in a modular fashion in the disc space between two adjacent vertebrae along the transverse width of the vertebrae.

25 Figure 20 is perspective view of an alternative embodiment of the spinal fusion implant of the present invention.

Referring to Figures 1-5, an embodiment of the translateral spinal fusion implant of the present invention, generally referred to by numeral 100, is shown. The spinal fusion implant 100 has a substantially cylindrical configuration having an outer wall 112 surrounding an internal chamber 114 for holding fusion promoting material. The exterior of the spinal fusion implant 100 comprises an external thread 116 suitable for engaging the vertebrae of the spine to stabilize the spinal fusion implant 100 across the disc space and into adjacent vertebrae once surgically implanted. The spinal fusion implant 100 has a removable cap 118 at one end which provides access to the internal chamber 114 and has an insertion end 120 adapted to engage insertion instrumentation.

The cap 118 is removable to provide access to the internal chamber 114, such that the internal chamber 114 can be filled and hold any natural or artificial osteoconductive, osteoinductive, osteogenic, or other fusion enhancing material. Some examples of such materials are bone harvested from the patient, or bone growth inducing material such as, but not limited to, hydroxyapatite, hydroxyapatite tricalcium phosphate; or bone morphogenic protein. The cap 118 and/or the spinal fusion implant 100 itself is made of material appropriate for human implantation such as titanium and/or may be made of, and/or filled and/or coated with a bone ingrowth inducing material such as, but not limited to, hydroxyapatite or hydroxyapatite tricalcium phosphate or any other osteoconductive, osteoinductive, osteogenic, or other fusion enhancing material.

The outer wall 112 comprises openings 122 which may be closed wells or openings communicating into the internal chamber 114 to permit bone ingrowth into the chamber 114.

5 Referring specifically to Figure 2, an elevational view of the anterior aspect of a segment of the spinal column S with the spinal fusion implant 100 inserted from the lateral aspect of the spinal column S into a hole  
10 bored into the adjacent vertebrae  $V_1$  and  $V_2$  across the disc space D. The spinal fusion implant 100 is inserted along the transverse width W of the adjacent vertebrae  $V_1$  and  $V_2$  such that the spinal fusion implant 100 extends  
15 translaterally in the direction from one lateral aspect of the vertebrae to the opposite lateral aspect of the vertebrae.

Referring to Figure 3, an elevational view of the lateral aspect of a segment of the lumbar spine S is shown with a first implant 100a, identical to spinal fusion  
20 implant 100, inserted from the lateral aspect into a hole bored across a first disc space  $D_1$  and into two adjacent vertebrae  $V_1$  and  $V_2$ , and a second implant 100b, identical to spinal fusion implant 100, inserted from the lateral aspect  
into a second hole bored across a second disc space  $D_2$  and into two adjacent vertebrae  $V_2$  and  $V_3$ .

25 The translateral implants of the present invention are inserted by the translateral method disclosed in copending Application Serial No. 08/394,836 entitled IMPROVED METHODS AND INSTRUMENTATION FOR THE SURGICAL  
CORRECTION OF HUMAN THORACIC AND LUMBAR SPINAL DISEASE FROM  
30 THE LATERAL ASPECT OF THE SPINE, filed on February 27, 1995, which is incorporated herein by reference.

Referring to Figure 4, a top sectional view along lines 4--4 of Figure 3 is shown illustrating the area of contact of the implant 100a and the vertebra  $V_1$ . The vertebra  $V_1$  has a depth D measured from the anterior to posterior aspect of the spine, and a transverse width W measured from one lateral aspect to the opposite lateral aspect of the vertebra  $V_1$ . The implant 100a has a length L that is substantially greater than the depth D of the vertebra  $V_1$ , such that the implant 100a may extend substantially across the transverse width W of the vertebra  $V_1$ . In the preferred embodiment, the implant 100a has a length L that is greater than one half the transverse width W of the vertebrae and has a diameter of a sufficiently large size that approximates the depth D of the vertebra  $V_1$ . As a result of the large length and diameter of the implant 100a, a large surface area of contact between the implant 100a and the vertebrae  $V_1$  is possible creating a highly stable construct. The implant 100a has a much greater surface area of contact with the vertebra  $V_1$  than was previously possible with implants that are inserted from the front or the back of the spine.

As described above in the Background of the Invention, a centrally placed single implant from either the front or the back of the patient must be large enough to occupy a sufficient portion of the transverse width W of the vertebrae to promote firm stability. However, the vertical height of such an implant and excursion into the adjacent vertebrae would be so severe that if any two consecutive disc spaces were to be operated upon, the vertebra in between the disc spaces would be cut in half.



Therefore it has been the practice to use multiple implants, one on each side of the center line (mid-sagittal axis) of the vertebrae, thereby providing a greater degree of stability.

Referring to Figure 5, an anterior elevational view of a segment of the lumbar spine S is shown with two cylindrical implants 150 and 152 inserted from the anterior aspect of the spine S into holes drilled across the same disc space D and into two adjacent vertebrae  $V_1$  and  $V_2$ .

Referring to Figure 6, sectional view along lines 6--6 of Figure 5 illustrating the area of contact between the two implants 150 and 152 inserted from the anterior aspect of the spine and the vertebra  $V_1$  is shown. As can be seen from Figure 6, the surface area of the two spinal implants 150 and 152 in contact with the vertebra  $V_1$  is substantially less than that of a single translateral spinal fusion implant 100 that is inserted across the transverse width W of the vertebra  $V_1$ . As a result, a more stable construct is achieved with the translateral spinal fusion implant 100 of the present invention than was previously possible with implants that are inserted from either the front or the back of the patient promoting from stability of the fusion construction.

In the preferred embodiment, the spinal fusion implant 100 of the present invention has an overall length in the range of 35 mm to 50 mm, with 38-44 mm being preferred, and a maximum diameter in the range of 22 mm to 30 mm, with 24-26 mm being preferred when inserted in the lumbar spine. In the thoracic spine such implants would have a length in the range of 12-30 mm, and a maximum diameter in the range of 14-26 mm, with the preferred

diameter being 20 mm.

Referring to Figure 7, an anterior perspective view of a single vertebra  $V_1$  and an alternative embodiment of the translateral spinal fusion implant of the present invention, generally referred to by the numeral 199, is shown. The spinal fusion implant 199 is a dowel inserted into a hole drilled across a disc space and into the vertebra  $V_1$  along the transverse width of the vertebra  $V_1$ . The spinal fusion implant 199 has the same dimensions as the spinal fusion implant 100 described above. The spinal fusion implant 199 can be made of any material suitable for human implantation may comprise fusion promoting and/or bioactive material to actively participate in the spinal fusion process. The implant 199 can be made of a porous, and/or mesh-like, and/or cancellous material, or any other material suitable for the described purpose.

Referring to Figure 8, an alternative embodiment of the translateral spinal fusion implant of the present invention, is shown and generally referred to by the numeral 200. The spinal fusion implant 200 has a substantially cylindrical configuration having a thin outer wall 212 surrounding an internal chamber 214. The exterior of the spinal fusion implant 200 comprises surface roughenings that provide a surface suitable for engaging the bone of the vertebrae to stabilize the spinal fusion implant 200 across the disc space and into the adjacent vertebrae once surgically implanted. The surface roughenings comprise a plurality of ratchetings 220 along the circumference of the spinal fusion implant 200. Each of the plurality of ratchetings 220 has a bone engaging edge 222 and an angled segment 224.

The spinal fusion implant 200 is implanted into a cylindrical bore derived across the disc space and into two adjacent vertebrae. The spinal fusion implant 200 may be pushed into the cylindrical bore across the disc space by direct, linear advancement since it requires no thread to pull it forward through the spine. As no torque is required to advance the spinal fusion implant 200 there is no minimum requisite height of the surface roughenings.

The ratchetings 220 may face in one direction, the direction in which the spinal fusion implant 200 is inserted, and function to prevent the spinal fusion implant 200 from backing out of the disc space in a direction opposite to the direction of insertion once inserted between the two adjacent vertebrae. The ratchetings 220 urge the spinal fusion implant 200 forward against the unremoved bone of the vertebrae. Since implants generally want to back out along the same path in which they are inserted, the ratchetings 220 tend to urge the spinal fusion implant 200 forward against the solid unremoved bone at the end of the cylindrical bone, further resisting dislodgement and controlling motion resulting in an exceedingly stable implantation.

The spinal fusion implant 200 has an engagement means at one end for engaging a driver instrument for intimately engaging and binding the implant 200 and the driver instrument together. Once affixed to the implant driver instrument, the spinal fusion implant 200 may be then introduced through a hollow cylindrical tube and driven into the cylindrical hole that has been drilled across the disc space. The implant driver instrument may then be impacted by a mallet, or similar device, to

linearly advance the spinal fusion implant 200 across the disc space. Once the spinal fusion implant 200 is inserted across the disc space, the ratchetings 220, engage the bone of the vertebrae and the implant driver instrument is detached from the spinal fusion implant 200.

Referring to Figure 9, an alternative embodiment of the spinal fusion implant of the present invention generally referred to by the numeral 300 is shown. The spinal fusion implant 300 has a substantially cylindrical configuration having surface roughenings for stabilizing the implant 300 within the intervertebral space D. The surface roughenings comprise a surface knurling 320 such as, but not limited to, the diamond-shaped bone engaging pattern shown in Figure 9. The spinal fusion implant 300 may have surface knurling 320 throughout the entire external surface of the spinal fusion implant 300, throughout only a portion of the external surface, or any combination thereof, without departing from the scope of the present invention. In those circumstances where there is no undrilled bone in the disc space forward of the spinal fusion implant 300 to resist further forward advancement of the implant, surface knurling 320 is preferred as it produces an exceedingly high interference fit with the bone of the vertebrae and resists motion equally in all directions and without the tendency to urge itself forward.

Referring to Figure 10, an alternative embodiment of the spinal fusion implant of the present invention is shown and is generally referred to by the numeral 400. The spinal fusion implant 400 has a similar configuration to that of the spinal fusion implant 200, except that it comprises a partially cylindrical member having arcuate

portions 402 and 404 which are arcs of the same circle with portions of its outer wall that are flattened so as to present a first flat side 406. Alternatively, the implant 400 may have a second flat side that is diametrically opposite to the first flat side 406. The spinal fusion implant 400 is substantially the same as the spinal fusion implant 200, except that the openings 428 are positioned on the ratcheting 420 such that the openings 428 are positioned between the bone engaging edges 422 and are not bisected by the bone engaging edges 422.

Referring to Figure 11, an alternative embodiment of the spinal fusion implant of the present invention is shown and generally referred to by the numeral 500. The spinal fusion implant 500 is substantially identical to the spinal fusion implant 400 described above except that in place of ratchetings 420, it has surface knurling 520. The surface knurling 520 assists in the retaining of the spinal fusion implant 500 once it is inserted across the disc space between two adjacent vertebrae. It is recognized that the surface knurling 520 of the implant 500 may be combined with any of a number of other surface roughenings such as, but not limited to, ratchetings to assist in retaining the spinal fusion implant 500 across the disc space.

Referring to Figure 12, an alternative embodiment of the spinal fusion implant of the present invention generally referred to by the numeral 600 is shown. The spinal fusion implant 600 has the same structure as the spinal fusion implant 300 described above but instead of knurling 320 has a different surface roughening. The spinal fusion implant 600 has a surface roughening

comprising of a blasted external surface 601 which may be stippled to provide an engagement surface for the vertebrae when inserted across the disc space. The spinal fusion implant has a plurality of openings 628, a removable cap 5 630 for accessing an internal chamber.

Referring to Figure 13, an alternative embodiment of the spinal fusion implant of the present invention generally referred to by the numeral 700 is shown. The spinal fusion implant 700 is similar to spinal fusion 10 implant 400 described above except that it has openings in the form of horizontal slots 728 on the flat side 706 and vertical slots 729 on the cylindrical portion of the spinal fusion implant 700. The spinal fusion implant 700 has ratchetings 720 for engaging the bone of the vertebrae 15 similar to the ratchetings 220 described above.

It is appreciated that the spinal fusion implants of the present invention may include any and all surface roughening configurations that either increase the surface area or interference fit of the implant and the vertebrae. 20 It is appreciated that the ratchetings described above for the various embodiments of the spinal fusion implants of the present invention may also comprise a knurled or other surface roughenings in combination with the ratchetings to further enhance the retention of the spinal fusion implant 25 across the disc space once inserted.

Referring to Figure 14, an alternative embodiment of the spinal fusion implant of the present invention is shown and generally referred to by the numeral 800. The spinal fusion implant 800 is similar in 30 configuration to the spinal fusion implant 100 discussed above. However, instead of an external thread, the spinal

fusion implant 800 has a plurality of longitudinal splines 810 along its external surface. The splines 810 are parallel to the central longitudinal axis L of the implant 800 in the direction of insertion of the implant 800. The  
5 splines 810 have a sharp edge 812 and a sharpened leading end 814 to facilitate insertion of the spinal fusion implant 800 into the adjacent vertebrae. Located between the splines 812 are a plurality of slots 820 that allow bone growth into the implant and into the internal chamber  
10 of the implant 800 during spinal fusion.

Referring to Figure 15, the spinal fusion implant 800 is shown inserted from the lateral aspect of the spine into a bore created across the disc space D and into the adjacent vertebrae  $V_1$  and  $V_2$  along the transverse width of  
15 the vertebrae  $V_1$  and  $V_2$ . The spinal fusion implant 800 is pushed into place by linear advancement such that the splines 810 engage a portion of each of the adjacent vertebrae  $V_1$  and  $V_2$ . The splines 810 function to engage the vertebrae  $V_1$  and  $V_2$  and stabilize the spinal fusion implant  
20 800 once implanted. The splines 810 are oriented longitudinally with respect to the spinal fusion implant 800 to prevent any dislodgement of the spinal fusion implant 800 from between the vertebrae  $V_1$  and  $V_2$  as result of anterior to posterior motion of the spine. It is  
25 appreciated that the number of splines 810 and the configuration of the splines 810 can vary depending on the size of the spinal fusion implant 800 being implanted.

Referring to Figure 16, an alternative embodiment of the spinal fusion implant of the present invention is  
30 shown and generally referred to by the numeral 900. The spinal fusion implant 900 differs from the implants

described above in that it is inserted in the disc space D between the adjacent vertebrae of the spine and not into a cylindrical bore created across the disc space. Therefore, the spinal fusion implant 900 does not require the removal of any portion of bone from the adjacent vertebrae as the spinal fusion implant 900 fits within the natural disc space between the adjacent vertebrae. However, the removal of at least a portion of the disc material present between the adjacent vertebrae is required for proper insertion.

The spinal fusion implant 900 comprises a rectangular block 901 having a top surface 902 and a bottom surface 904 for engaging the adjacent vertebrae and may be flat or may conform at least in part. The top and bottom surfaces 902 and 904 may comprise any of the surface roughenings described herein for engaging the bone of the adjacent vertebrae to promote firm stability. The spinal fusion implant 900 may be solid or hollow at least in part and have a plurality of openings 906 to allow bone ingrowth. The openings 906 may be present on all surfaces of the implant 900 and may either pass through the entire implant 900, or may be closed bottom wells for holding fusion promoting materials.

Referring to Figure 17, the spinal fusion implant 900 is shown implanted from the lateral aspect of the spine in the disc space D between two adjacent vertebrae V, V<sub>1</sub> and V<sub>2</sub> along the transverse width of the adjacent vertebrae V<sub>1</sub> and V<sub>2</sub>. The spinal fusion implant 900 has a height that is substantially equal to the height of the disc space D, a length that is greater than one half the transverse width W of the vertebrae and a width that approximates the depth of the vertebrae.



In the preferred embodiment, the spinal fusion implant 900 has a height in the range of 8 mm to 16 mm, with the preferred height being 10-12 mm; a width in the range of 24 mm to 32 mm, with the preferred width being 26 mm; and a length in the range of 32 mm to 50 mm, with 42 mm being the preferred length.

Referring to Figure 18, an alternative embodiment of the spinal fusion implant of the present invention is shown and generally referred to by the numeral 1000. The spinal fusion implant 1000 is similar to the spinal fusion implant 900, but has a narrower width such that more than one spinal fusion implant 1000 may be combined in a modular fashion for insertion within the disc space D between the adjacent vertebrae.

Referring to Figure 19, a plurality of spinal fusion implants 1000 are shown combined in a modular fashion inserted in the disc space D from the lateral aspect of the spine and along the transverse width of the vertebrae  $V_1$  and  $V_2$ .

Referring to Figure 20, an alternative embodiment of the spinal fusion implant of the present invention is shown and generally referred to by the numeral 1100. The spinal fusion implant 1100 is inserted into the disc space between two adjacent vertebrae from the lateral aspect of the spine and along the transverse width of the vertebrae. The implant 1100 is dimensioned to replace the natural disc material present between two adjacent vertebrae. The implant 1100 has a generally rectangular body with curved sides 1102 and 1104. The top and bottom surfaces 1106 and 1108 have a plurality of splines 1110 similar in structure and function as the splines 810 described above. As the

implant 1100 is inserted in the disc space, the splines 1110 engage the bone of the adjacent vertebrae.

5 The implant 1100 is shown as being hollow with openings 1112 and slots 1114 in the outer surface of the implant 1100 permitting bone ingrowth into the interior of the implant 1100. However, it is appreciated that the implant 1100 may be solid and may have channels or wells in place of opening 1112 to permit bone ingrowth and incorporation of the implant 1100 into the spinal fusion mass. The interior of the implant 1000 may be accessed through the aperture 1120 which may be closed with a snap fit cover.

15 While the present invention has been described in detail with regards to the preferred embodiment, it is appreciated that other variations of the present invention may be devised which do not depart from the inventive concept of the present invention.

What is claimed is:

1. A translateral spinal fusion implant for insertion from the lateral aspect of the spine in the disc space between two adjacent vertebrae, said implant having a length that is substantially greater than one half the transverse width of the vertebrae, said length being substantially greater than the depth of the vertebrae, and a height that is substantially equal to the disc space.
2. The spinal implant of claim 1 in which said implant has a height that is greater than the disc space and is capable of engaging both of said vertebrae.
3. The spinal implant of claim 2 in which said implant is cylindrical in shape.
4. The spinal implant of claim 1 in which said implant has surface roughenings for engaging said two adjacent vertebrae and for maintaining said implant in place, said surface roughenings being present on at least a portion of the exterior of said implant.
5. The spinal fusion implant of claim 4 in which said surface roughenings include a plurality of ratchetings.
6. The spinal fusion implant of claim 5 in which said ratchetings face one direction.
7. The spinal fusion implant of claim 4 in which said surface roughenings include knurling.

8. The spinal fusion implant of claim 4 in which said surface roughenings include a plurality of longitudinal splines.

5 9. The spinal fusion implant of claim 3 in which said implant has an external thread for engaging the vertebrae.

10. The spinal fusion implant of claim 3 in which said implant is hollow.

10

11. The implant of claim 7 in which said implant has a cap on at least one end for removably closing said hollow portion of said Implant.

15 12. The spinal fusion implant of claim 1 having a plurality of openings capable retaining fusion promoting material.

20 13. The spinal fusion implant of claim 1 in which one end of said implant includes an engagement means for engaging instrumentation for the insertion of said implant.

25 14. The spinal fusion implant of claim 1 in which said implant comprises a fusion promoting material.

15. The spinal fusion implant of claim 1 in which said implant is at least in part bioabsorbable.

30 16. The spinal fusion implant of claim 1 in which said implant has an internal chamber and an access opening for accessing said internal chamber.

17. The spinal fusion implant of claim 22 in which said implant has means for closing said access opening.

18. The spinal fusion implant of claim 16 in which said internal chamber is capable of containing fusion promoting material.

19. The spinal fusion implant of claim 16 in which said implant comprises a wall surrounding said internal chamber.

20. The spinal fusion implant of claim 19 in which said wall has a plurality of openings passing therethrough in communication with said internal chamber.

21. The implant of claim 1 in which said implant includes driving engaging means for engaging a driving instrument for implanting said implant within the disc space between the two adjacent vertebrae.

22. The implant of claim 1 in which said implant is generally rectangular in shape.

23. The implant of claim 1 in which said implant is generally square in shape.

24. The implant of claim 1 which said implant comprises a plurality of modular members, each of said modular members having a length that is substantially greater than one half the transverse width of the vertebrae, said length being substantially greater than the depth of the vertebrae, a height substantially equal to the height of the space

created by the removed disc material from between two adjacent vertebrae, and a width substantially less than the depth of the vertebrae.

- 5      25. A translateral spinal fusion implant for insertion from the lateral aspect of the spine in the disc space between two adjacent vertebrae, comprising:

10            a plurality of modular members, each of said modular members having a length that is substantially greater than one half the transverse width of the vertebrae, said length being substantially greater than the depth of the vertebrae, a width substantially less than the depth of the vertebrae, and a height that is substantially equal to the disc space, each of  
15      said modular members comprising:

                upper and lower walls, and side walls,  
                said upper and lower walls forming a support structure including at least a portion of the interior surface of said upper and lower  
20            walls for bearing against the end plates of the adjacent vertebrae,

                whereby said plurality of modular members are capable of being inserted in between said two adjacent vertebrae.

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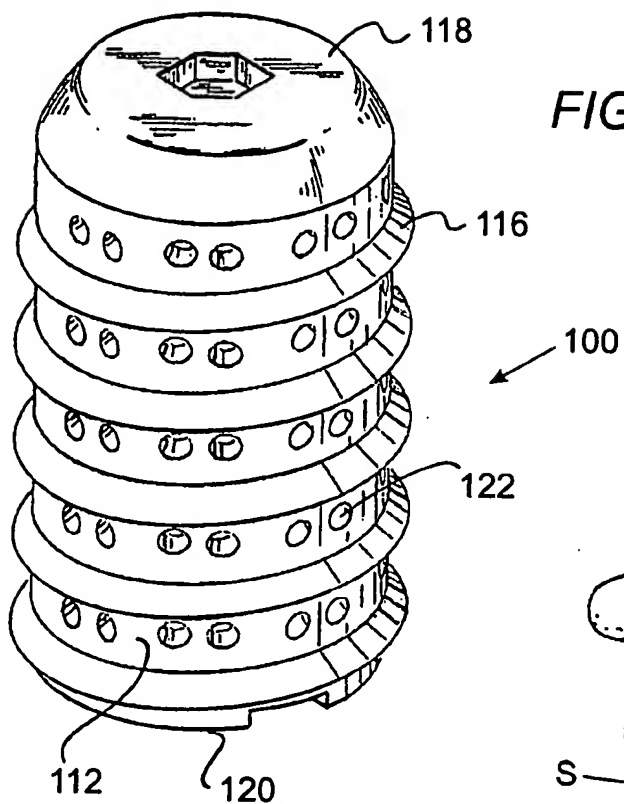


FIG. 1

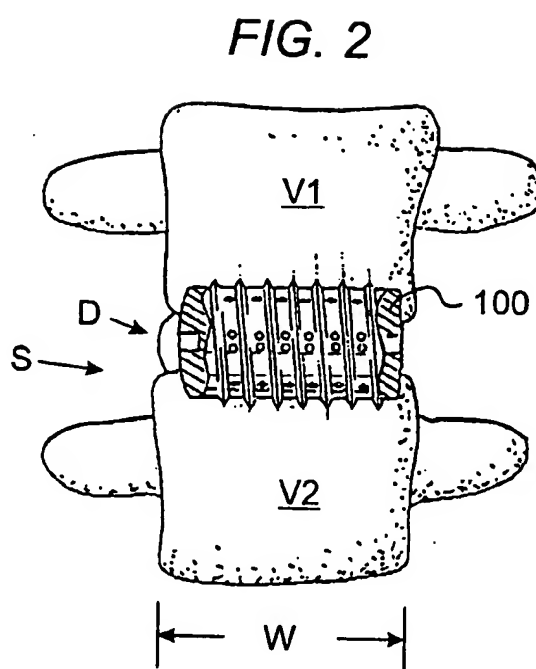


FIG. 2

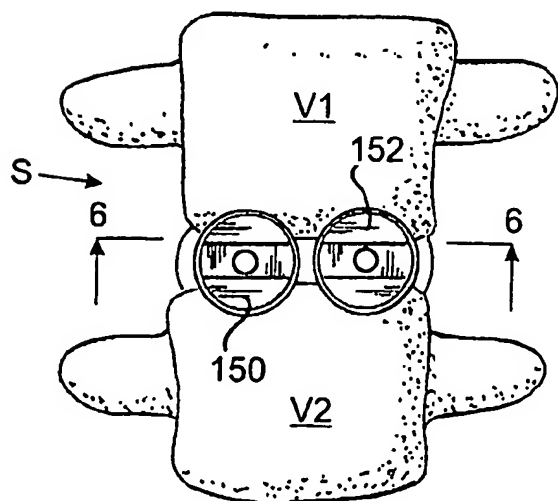


FIG. 5

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FIG. 3

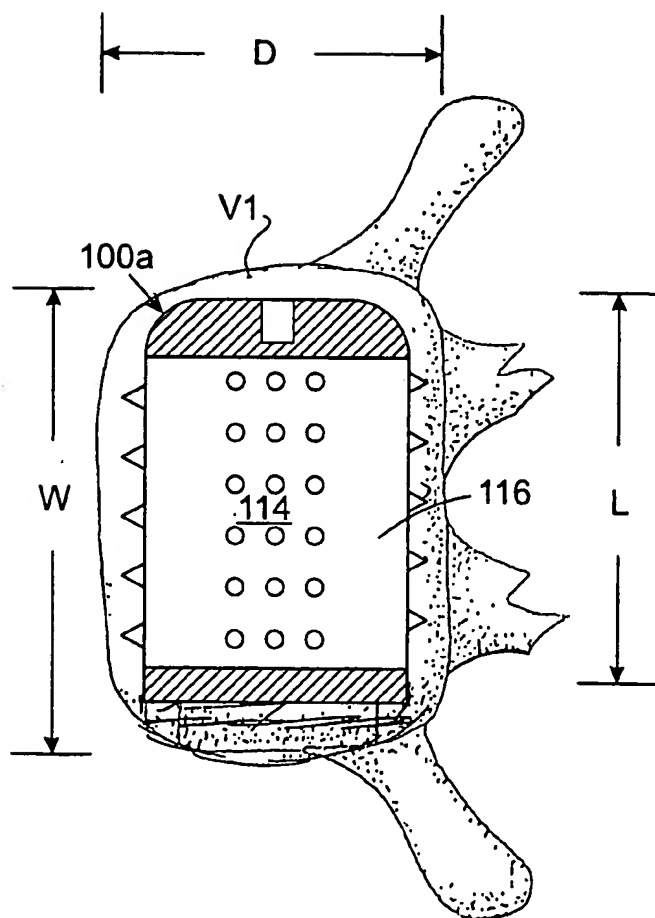
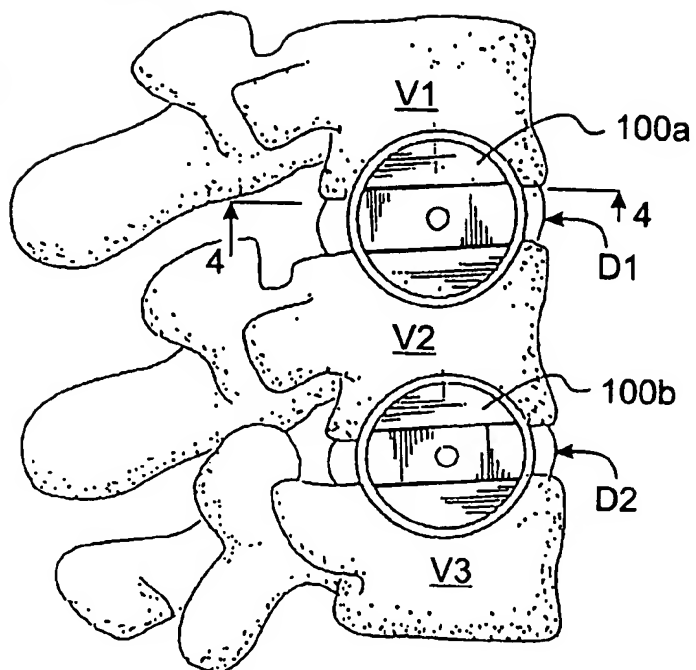


FIG. 4



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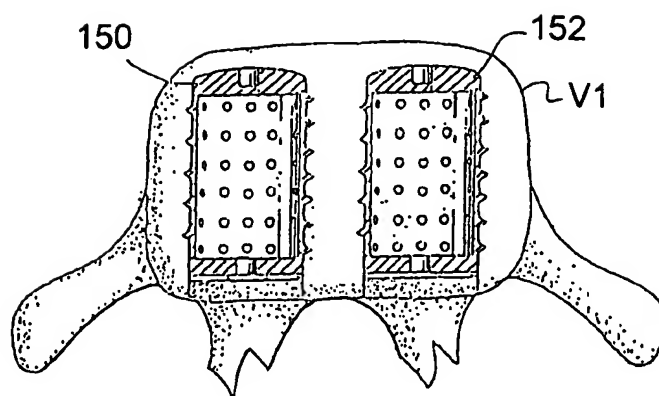


FIG. 6

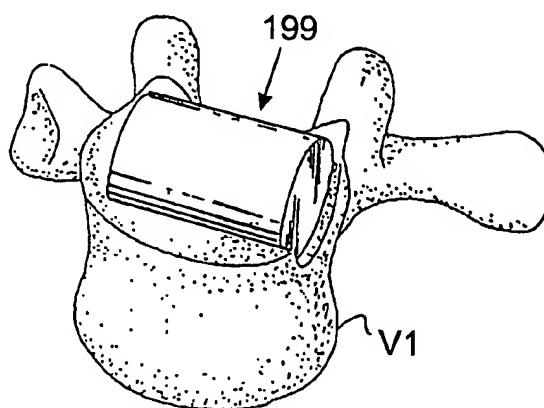


FIG. 7

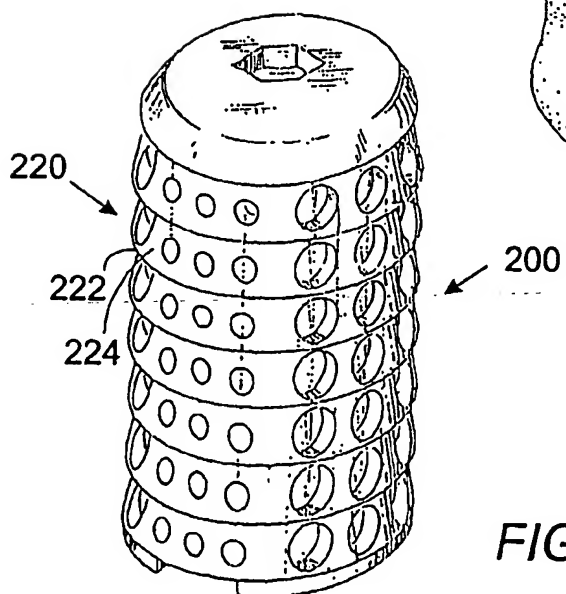


FIG. 8

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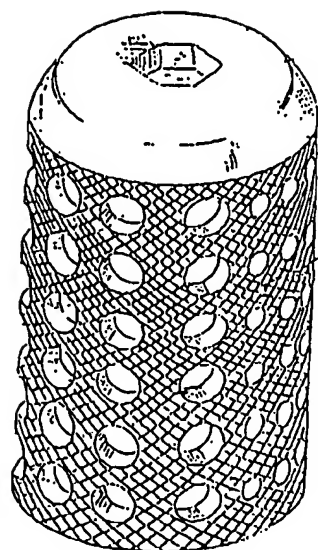


FIG. 9

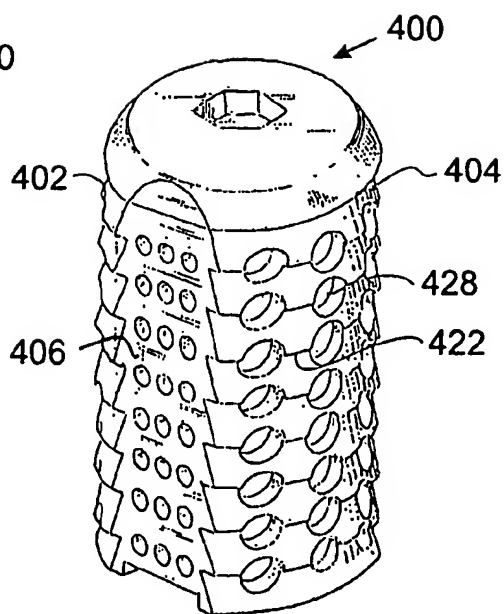


FIG. 10

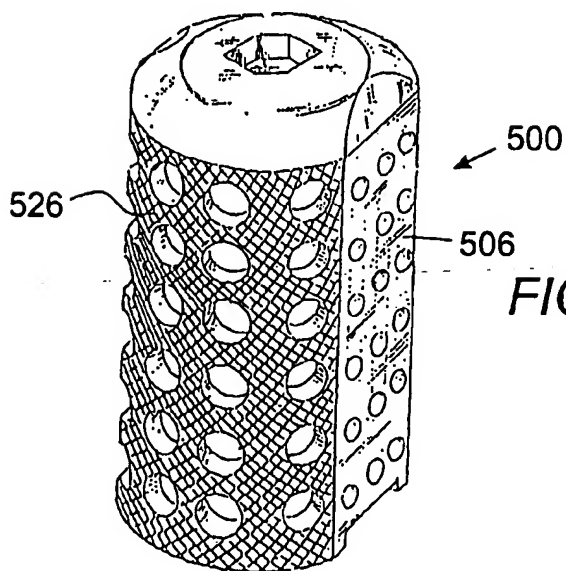


FIG. 11

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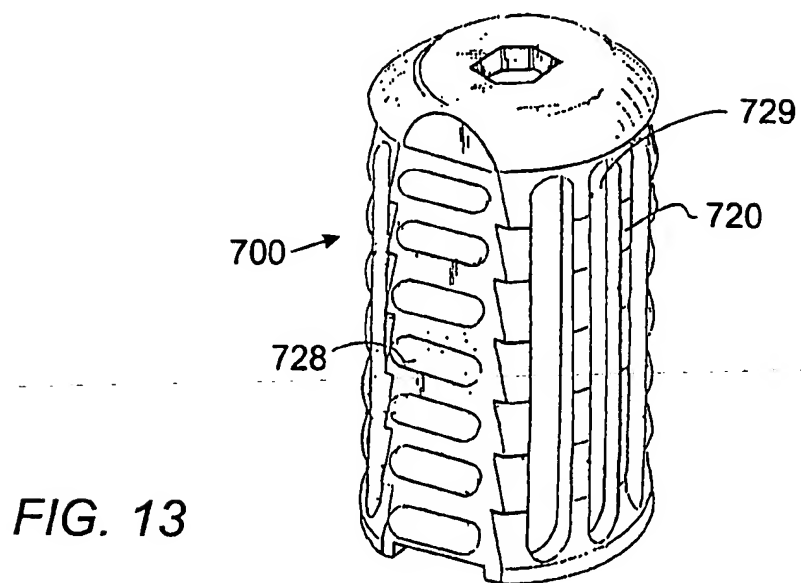
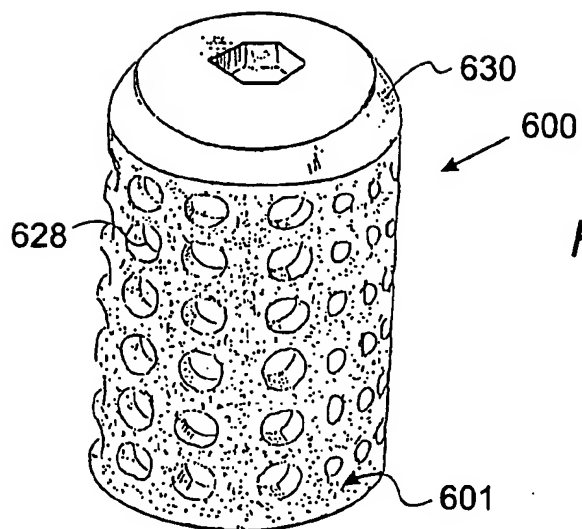


FIG. 18

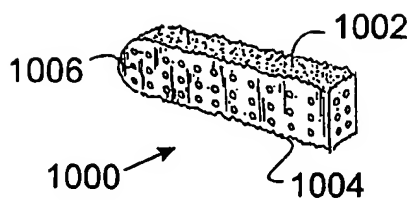


FIG. 16

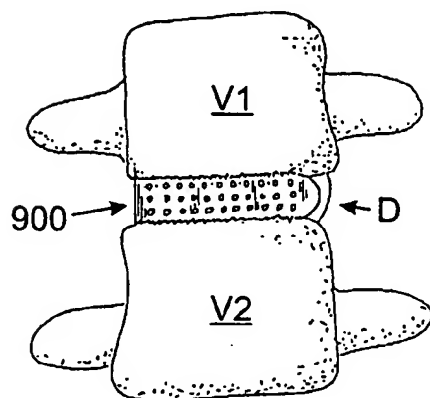
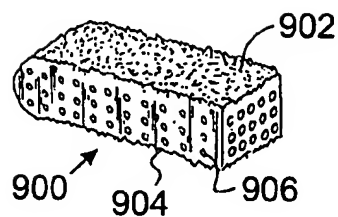
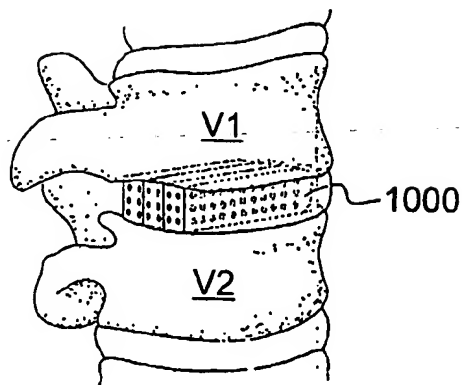


FIG. 17

FIG. 19



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FIG. 15

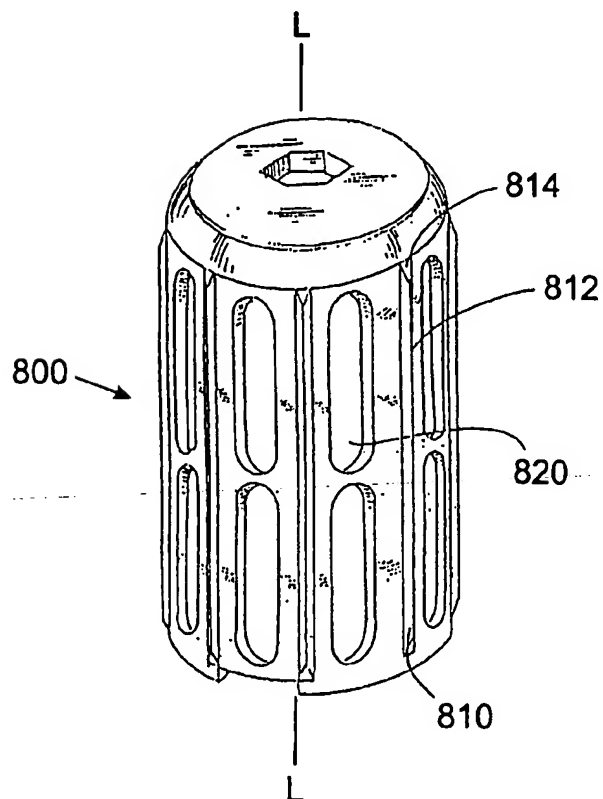
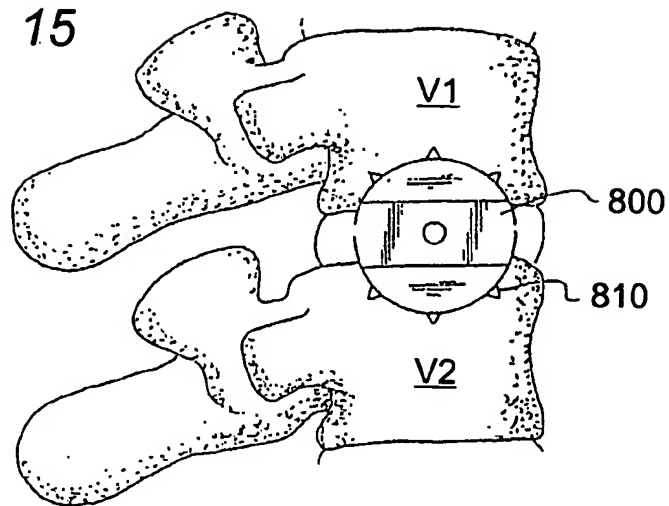
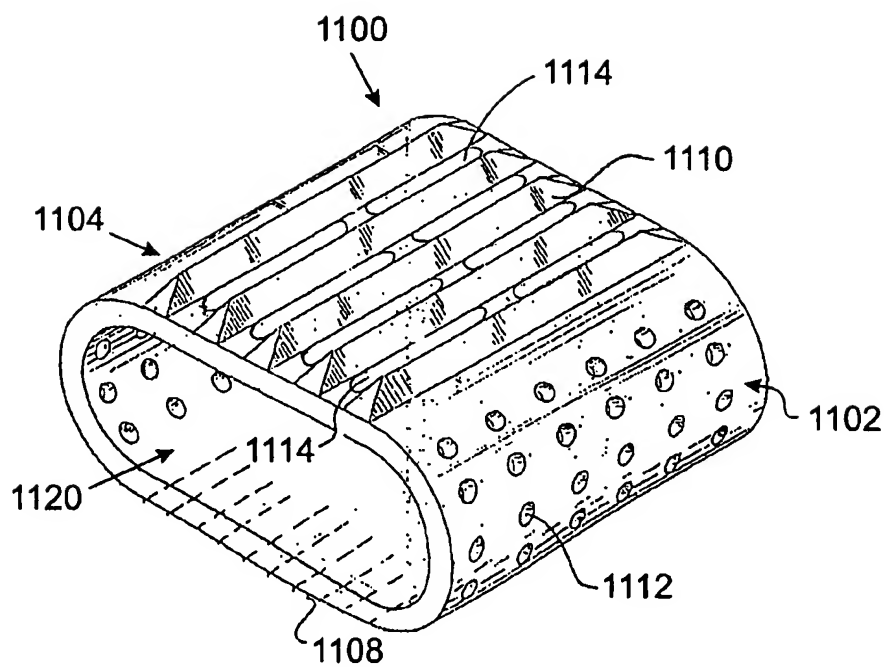


FIG. 15b

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**FIG. 20**